COMP308

Efficient Parallel Algorithms

Time allowed: Two hours and a half

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Credit will be given to the best four questions only

If you attempt to answer more than the required number of questions
(in any section) the marks awarded for the excess questions will be
discarded (starting with your lowest marks)

1.

   a) List advantages and disadvantages of the Parallel Virtual Machine.   (8 marks)

   b) Why is the Parallel Random Access Machine (PRAM) model useful?   (7 marks)

   c)   Describe the write conflicts in a PRAM model.   (5 marks)

   d) Describe how the "parallel do" statement works in a PRAM model.   (5 marks)

2.

   a) Describe $O(\log n)$ parallel time recursive computation of the prefix sums
      on a PRAM.

                  (10 marks)

   b) Describe an $O(\log n)$ parallel time computation of the maximum of n numbers
      on a PRAM.   (8 marks)

   c) What are the advantages of the balanced binary tree technique in parallel
   computations?   (7 marks)

3.

   a) Draw a sorting network which sorts sequences of 8 elements in 7 parallel steps.

                 (13 marks)

   b) Use the zero-one principle to show that testing correctness of a merging network
      can be done sequentially in polynomial time.   (12 marks)

4.

    a) Describe the notions of a simple bitonic and a bitonic sequence. Give

      an example of a (general) bitonic sequence which is not simple bitonic.

                                                   (10 marks)

    b) Describe how the bitonic merging network works.   (15 marks)

5.

    a) Describe the hypercube network of processors.   (8 marks)

    b) Describe the perfect shuffle network of processors.   (8 marks)

    c)   Describe how to add n numbers on the hypercube in logarithmic time

                                                   (9 marks)

6.

    a) What does it mean that a problem is P-complete ?   (5 marks)

    b) List and define two P-complete problems.   (8 marks)

    c) Describe the pebble-driven algorithm of tree contraction.   (12 marks)